# THE PHYSIOLOGICAL DEMANDS OF TOUCH RUGBY

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# RESEARCH PROJECT TITLE

# (THE PHYSIOLOGICAL DEMANDS OF TOUCH RUGBY)

**by**

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No portion of the work referred to in this Research Project has been submitted in support of an application for another degree or qualification of this, or any other University or institute of learning.

The project was supervised by a member of academic staff, but is essentially the work of the author.



Signed ………… Robert Beaver …………..

Date ………… 30$^{th}$ September 2013 …………

**Abstract**

This study quantified and compared the internal and external match demands on regional and national standard male touch rugby players. It adopted an independent measures cohort design where nine regional players (mean age 25.5 ± 5.5 years, body mass 74.2 ± 7 kg, stature 174.1 ± 7 cm) and 12 national players (mean age 27.8 ± 6.2 years, body mass 72.8 ± 3.7 kg, stature 174.5 ± 5.4 cm) were analysed during competitive matches from the 2013 season using global satellite positioning technology (GPSports, Australia). This provided 33 regional and 55 national match files for analysis. Independent samples *t*-tests detected significant differences ($p<0.05$) in the time players spent on the pitch (ES = 1.13), total distance (m) (ES = -1.26), total relative distance ($m \cdot min^{-1}$) (ES = 0.72), relative high intensity (>14 $km \cdot h^{-1}$) distance ($m \cdot min^{-1}$) (ES = 1.04), absolute low intensity (<14 $km \cdot h^{-1}$) distance (m) (ES = -1.25), work to rest for time and distance (ES = -0.98 and -0.94, respectively), total sprint (> 20 $km \cdot h^{-1}$) distance (m) (ES = 1.0), relative total sprint distance ($m \cdot min^{-1}$) (ES = 1.39), number and frequency of sprints performed (ES = 0.6 and 1.15, respectively), peak speed ($km \cdot h^{-1}$) (ES = 0.8) and average match speed ($km \cdot h^{-1}$) (ES = 0.8), average (ES = -0.61) and summated heart rate (ES = -1.7), and session RPE (ES = -1.7). It was concluded that as differences in match demands exist, coaches should make training as specific as possible, and by doing so, better prepare touch rugby players for competition. Furthermore, improving aerobic capacity and the quantity of sprint/high intensity work performed may assist those players transitioning from regional to national standard.

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# Chapter 1 – Introduction

"Touch rugby" is the latest variant of rugby established in the 1960s. Over the last few years its popularity has grown with over 15,000 registered players in the UK and over 35,000 in Europe (European Touch Federation, 2013). It is an intermittent high intensity team sport where players perform frequent periods of high intensity activity (such as sprinting) separated by periods of low intensity activity (such as standing, walking and jogging) (Ogden, 2010). Teams consist of 14 players with six being allowed on the pitch at any one time (Ogden, 2010). As with the other rugby variants (union, league and 7s), the aim is to score tries; in touch, this being the only means to score points. Unlike the other rugby variants, touch players do not experience high impact collisions, such as that associated with tackling (Allen, 1989). In touch, tackling is limited to placing a single hand on the ball carrying player (Allen, 1989). After being "touch" tackled the defending team retreats 5 m from where the tackle occurred. The attacking team is allowed up to six tackles to score; after which (or if an error occurs in the interim), the opposition gains possession of the ball and becomes the attacking side (International Touch Federation, 2013). Compared to the other rugby variants, touch has the fewest players on the pitch; a smaller playing area (70 x 50 m compared to 100 x 70 m); a different playing duration (2 x 20 minutes halves with a 3 minute half-time period); and an unlimited substitution rule allowing players to have multiple off-pitch recovery periods during matches (Coffey, 2007; Walsh, Heazlewood & Climstein, 2012). Touch players specialise in one of three competition categories: male only, female only and mixed sex teams (International Federation of Touch Rugby, 2013).

Unlike the more established rugby codes, limited research exists on the match demands of touch rugby. Therefore, touch rugby coaches have little information on how to optimally prepare players for competition (Suarez-Arrones, Nunez, Portillo & Mendez-Villanueva, 2012a; Waldron, Twist, Highton, Worsfold & Daniels, 2011; Cunniffe, Proctor, Baker & Davis, 2009). Knowledge of the internal (such as, heart rate and rating of perceived exertion) and external (such as, speed and distance covered) match demands allows a coach to tailor training sessions to the sport's demands (Gray & Jenkins, 2010; Reilly, Thomas & Whyte, 2009; Impellizzeri, et al., 2006). Such sport specific conditioning is an effective way to prepare players for competition, promoting relevant and specific physical development whilst aiding the transfer of such improvements to a competitive environment (Kennett, Kempton & Coutts, 2012; Suarez-Arrones, Nunez, Portillo & Mendez-Villanueva, 2012a). Knowing these demands can also identify optimal player recovery times (Sweet, Foster, McGuigan & Brice, 2004). The greater the physiological load, the more recovery time is required to avoid injury or a reduction in the ability to train (Gabbett & Domrow, 2007; Signh, Guelfi, Landers, Dawson & Bishop, 2011). Furthermore, it can provide quantitative information over reductions in a player's work-rate, indicating optimal timings for substitutions (Sykes, Twist, Nicholas & Lamb, 2011). Fatigue is believed responsible for reductions of up to 30% in the quantity of high intensity work (>14.4 $km \cdot h^{-1}$) performed during the latter stages of a match (Mohr, Krustrup, & Bangsbo, 2003; Higham, Pyne, Anson & Eddy, 2012). Also, players can experience temporary in-match fatigue with a 10-30% reduction in high intensity work performed over the 5 minute period immediately after their most intensive exercise bout (Mohr et al., 2003; Cunniffe et al., 2009). Optimising substitution timings (making use of the unlimited substitution rule) should maximise the quantity of high intensity effort; potentially a key factor in influencing the match outcome (Higham et al., 2012).

Previous studies demonstrate differences exist between the internal and external match demands of rugby league, rugby union and rugby 7s (Sykes, Twist, Hall, Nicholas & Lamb, 2009; Deutch, Kearney & Rehreret, 2007; Higham, et al., 2012; Sykes et al., 2011). An example being the distance players cover during matches; rugby 7s (1,350-1,975 m; Suarez-Arrones et al., 2012a), rugby league (4,219-6,917 m; Waldron et al., 2011) and rugby union (5,158-7,100 m; Cahill, Lamb, Worsfold, Headey & Murray, 2013). This is still the case when expressed relative to playing time, with players covering 115-120 $m \cdot min^{-1}$, 88-100 $m \cdot min^{-1}$ and 70-80 $m \cdot min^{-1}$ in rugby 7s, league and union, respectively (Higham et al., 2012; Waldron et al., 2011; Austin & Kelly 2013; Cunniffe et al., 2009). Smaller differences in heart rates are reported (when averaged over the duration of a match) with players typically competing at 83 ± 4.8%, 85 ± 1% and 88 ± 3% of their maximum heart rate during elite rugby league, rugby union and rugby 7s matches, respectively (Coutts, et al. 2003; Cunniffe, et al., 2009; Suarez-Arrones, et al., 2012b). These differences could result from the rugby codes having different rules, player numbers and match durations (Casamichana & Castellano, 2010; Kennett et al., 2012; Hill-Hass, Dawson, Coutts & Roswell, 2009). Indeed, higher average heart rates, total distance covered and high intensity running have been observed during small-sided games with fewer players on the pitch (Hill-Hass et al., 2009). Such conditions provide more space for players to run, allowing greater distances to be covered and higher speeds attained (Kennett et al., 2012). These differences suggest players should train according to the demands of their rugby code to optimally prepare for competition (Gabbett, Jenkins & Abernethy, 2009).

Despite touch rugby's popularity, few studies have investigated the internal and external loads imposed on players during matches; none being conducted on players from the northern hemisphere. O'Conner (2002) reported average match heart rate to be greater than 90% of maximum heart rates for Australian national players. O'Conner (2002) also identified players spent 11% of match time performing high intensity activity (although this was not translated into distance covered). Reporting the percentage of time spent in speed categories alone might mask changes in exercise intensity and the true distance covered within each zone (Sykes et al., 2011). Instead, Sykes et al. (2011) propose reporting locomotive rates as a more informative means of quantifying external loads in team sports. Since the O'Conner (2002) study, the match duration for touch rugby has increased from 30 to 40 minutes. Increased playing time will influence the demands placed upon players as other studies report changes in distance covered and work intensity (per minute) completed for players who spend different amounts of time on the pitch (Waldron, Daniels, Highton & Twist, 2013; Gabbett, 2013a). Ogden (2010) reported elite New Zealand touch rugby players covered up to 3.1 km per match (including half-time and movements whilst off the pitch), with 0.9 km of this at high intensity (> 12 $km \cdot h^{-1}$). Whilst the absolute distance covered by the players was reported, Ogden (2010) did not present them relative to the time they actually spent on the pitch. Movement data should be standardised per unit of playing time as absolute distance is likely to misrepresent the actual work intensity performed (Aughey, 2010). This is particularly important in touch rugby as its unlimited substitution rule allows players to have multiple and differing lengths of time on the pitch. Providing relative movement data recognises players spend differing amounts of time on the pitch, thus taking the unlimited substitution rule into account. Ogden (2010) also utilised a 1 Hz Global Positioning System (GPS) to measure the distances players covered, which Aughey (2010) claims is sub-optimal for quantifying movement of short duration (< 1 s). Indeed, Duffield, Reid, Baker and Spratford (2010) found differences of up to 27% between 1 Hz and 5 Hz GPS devices when recording speeds and distances during the same exercise bout. Similarly, Jennings, Cormack, Coutts, Boyd, and Aughey (2010) concluded the 5 Hz system is more accurate (with typical error statistics being 4% better than 1 Hz systems) for quantifying high intensity activity as the greater sampling frequency detects smaller intervals of the speed and distance covered.

Not only is there limited research on the physiological demands of touch rugby, no previous study has investigated whether these demands differ between playing standards. This information is important as it could highlight appropriate training strategies for players of different standards to optimally develop (Mohr, Krustrup, Anderson, Kirkendal & Bangsbo, 2008). Previous research from team sports, such as football (Mohr et al., 2008; Bradley, Di Mascio, Peart, Olsen & Sheldon, 2012), hockey (Jennings, Cormack, Coutts & Aughey, 2012), Australian football (Aughey, 2013), basketball (Abdelkrim, Castanga, Fazza & Ati, 2010), rugby league (Sirotic, Coutts, Knowles & Catterick, 2009; Gabbett, 2013b) and rugby 7s (Higham et al., 2012) all indicate differences exist in the physiological match demands imposed on players of differing ability. Elite players tend to perform more higher intensity exercise (especially during the latter stage of a match), cover greater distances relative to playing time, achieve greater average sprint distances and compete at a higher percentage of their maximum heart rate (Higham et al., 2012; Sirotic et al., 2009; Anderson, Randers, Heiner-Moller, Krustrup & Mohr, 2010). This could be due to physical differences, as elite players tend to have a greater aerobic capacity, a higher maximum sprint speed and increased anaerobic power compared to lesser standard players (Gabbett, 2013b; Gabbett & Domrow, 2009). Knowledge of how match demands vary at different playing standards helps coaches devise more tailored training, allowing them to better prepare the transition from sub-elite to elite status (Aughey, 2013; Reilly et al., 2000).

As match demand information is important for sport specific training and little is known for touch rugby at any playing standard, the purpose of this study was to quantify and compare the internal and external match demands on regional and national standard male touch rugby players.

## Chapter 2 - Methods

### Participants

Twenty one volunteer adult players (mean age 26.2 ± 6 years; body mass 73.5 ± 6.3 kg; stature 175.3 ± 6.2 cm) specialising in the male only touch rugby category provided written consent to participate in the study (see appendix 1 for example form). Players were split into two playing standards; regional (those who represented their region in a Touch England recognised competition) providing nine players (mean age 25.5 ± 5.5 years, body mass 74.2 ± 7 kg and stature 174.1 ± 7 cm) or national (those who represented their country at an international touch tournament) providing twelve players (mean age 27.8 ± 6.2 years, body mass 72.8 ± 3.7 kg and stature 174.5 ± 5.4 cm). Players who competed at both male only playing standards were analysed only at the national standard (Sirotic et al., 2009).

Each player was analysed during 2-5 competitive matches held in official (Touch England recognised) international and regional tournaments during the 2013 season. This produced 55 match files for national and 33 match files for regional playing standards. All national standard matches were won with a mean score deficit of 8 ± 4 points. Regional standard matches resulted in one draw, the rest all won, with a mean score deficit of 2 ± 2 points. All players were free from injury and any match files where the player obtained an injury were discarded from analysis. Players were advised to maintain their normal pre-match preparation and post-match recovery strategies during the data collection period.

Ethical approval from the Faculty of Applied Sciences ethics committee at the University of Chester and consent from the participant's national governing body (see appendix 2) were obtained before data collection began.

**Study Design**

The study adopted an independent measures cohort design, using GPS time motion analysis to quantify the player's: absolute (m) and relative ($m \cdot min^{-1}$) distance covered in sprint (>20 $km \cdot h^{-1}$), high (>14 $km \cdot h^{-1}$), and low (<14 $km \cdot h^{-1}$) speed categories; total absolute (m) and relative ($m \cdot min^{-1}$) distance covered; number of sprints per minute; average sprint run distance (m); peak and average speed ($km \cdot h^{-1}$); and work to rest ratio (the ratio between high and low intensity performed) for time and distance; all of which were compared across the playing standards. The number of satellites available for GPS signal transmission averaged 9 ± 1 (5-11 range) during the analysed matches, which is considered optimal for assessing human movement using GPS technology (Jennings et al., 2010). Session RPE, average and summated heart rates, average number of bouts, average bout time and total playing time were also compared across the playing standards. The independent variable was the playing standard (national or regional). The dependent variables were the aforementioned external and internal physiological demands measured for each player.

## Procedure

All matches were played outdoors on a dry natural grass surface between 09.50 and 18.00 hours, at an average temperature of 16.5 ± 1.2$^{o}$C. The procedure was based on the methods adopted by Waldron, et al. (2011) to establish the physiological match demands of elite rugby league. Thirty minutes prior to each match, players put on a GPS vest (GPSports, SPI-Pro, Canberra, Australia) containing a GPS unit (mass 86 g; size = 0.8 x 0.4 x 0.2 cm) (GPSports, SPI-Pro, 5 Hz, Canberra, Australia) ensuring the units position was between the player's scapulae. This model of GPS unit has good test-retest reliability with a coefficient of variance (CV) of 1.6% and 2.3% for speed and distance, respectively (Waldron, Worsfold, Twist & Lamb, 2011). Each player also wore a heart rate monitor (Polar electro, Finland) put on 30 minutes prior to matches ensuring the electrodes were moist and in contact with the skin of the chest. Players completed a 15-30 minute self-led warm-up prior to each match (any data recorded during this time being excluded from analysis). A digital watch (Illuminator, Casio, China), synchronised to Greenwich Mean Time recorded the start and end times of each half. These times marked the start and end points for analysis in each GPS match file. During matches, the times players entered and left the pitch were recorded live, via hand notation. This allowed data to be later split so only information recorded whilst players were on the pitch was analysed. Twenty minutes after a match each player individually provided (away from teammates to avoid any peer pressure) a session rating of perceived exertion (using a 10 point RPE scale), which was then multiplied by their playing duration (Foster et al., 2001; Ribeiro, Alves, Silva & Fontes, 2013).

Heart rate (beats·min$^{-1}$) was recorded during matches and used to calculate each individual's average percentage of peak heart rate. The peak heart rate was taken as the highest value obtained during match play. A peak value established this way has been shown to be equal to (and in some cases greater than) the maximal heart rate obtained during incremental field and laboratory tests (Cunniffe et al., 2009; Suarez-Arrones, Nunez, Portillo & Mendez-Villanueva, 2012b). Summated heart rates were calculated based on the methods outlined by Edwards (1993); summated heart rate being = (duration in zone 1 x 1) + (duration in zone 2 x 2) + (duration in zone 3 x 3) + (duration in zone 4 x 4) + (duration in zone 5 x 5); where zone 1 = 50-60% peak heart rate, zone 2 = 60-70% peak heart rate, zone 3 = 70-80% peak heart rate, zone 4 = 80-90% peak heart rate, and zone 5 = 90-100% peak heart rate.

Team AMS Version 2.1 GPS software (GPSports, Canberra, Australia) was used to split data into the following three speed categories; low (<14 km·h$^{-1}$), high (>14 km·h$^{-1}$) and sprint (>20 km·h$^{-1}$). These speed categories have been used in other similar studies when quantifying match demands of elite rugby 7s and rugby league

(Higham et al., 2012; Waldron et al., 2011; Suarez-Arrones et al., 2012a&b). The recorded movement variables included: absolute (m) and relative ($m \cdot min^{-1}$) distance covered in each speed category; total absolute (m) and relative ($m \cdot min^{-1}$) distance covered; number of sprints per minute; average sprint run distance (m); peak and average speed ($km \cdot h^{-1}$); and work to rest ratio for time and distance. Average heart rate ($beats \cdot min^{-1}$), summated heart rate, session RPE, number of bouts as well as the time spent on the pitch during each match was also recorded.

## Statistical Analysis

Violations of normality and homogeneity in the data were assessed using the Shapiro-Wilk and Levenes tests, respectively; an alpha level of >0.05 was used to satisfy both assessments. Separate independent sample *t*-tests were performed on all variables, using an alpha level of <0.05 to detect differences between regional and national standard match demands. Data for each variable was presented as a mean ± standard deviation, and its range. In an attempt to describe the data further, 95% confidence intervals (CI) of the difference for each variable were calculated. Effect sizes (ES) were calculated using the method outlined by Hopkins (2006) with <0.2, 0.21–0.6, 0.61–1.2, 1.21–1.99, and >2.0 representing trivial, small, moderate, large and very large effect magnitudes, respectively. A Pearson's correlation between the number of playing bouts and quantity of high intensity exercise ($m \cdot min^{-1}$) was performed, using an alpha level of <0.05 to detect a significant relationship.

## Chapter 3 - Results

Regional players spent longer periods of time on the pitch compared to national players ($p<0.05$, ES = 1.13). However, there was no difference in the number of bouts players performed for each playing standard ($p>0.05$, ES = 0.03), nor in the average bout time between playing standards ($p>0.05$, ES = -0.43). This data is presented in Table 1.

Regional players covered a greater total distance (m) than national players ($p<0.05$, ES = -1.26). However, when standardised per minute of playing time ($m \cdot min^{-1}$), national players covered a greater distance ($p<0.05$, ES = 0.72; Table 2). There was no difference in the absolute high intensity distance (m) covered between the playing standards ($p>0.05$, ES = 0.28). However, when standardised per minute of play ($m \cdot min^{-1}$), national players covered more distance at high intensity ($p<0.05$, ES = 1.04; Table 2). National players also covered less distance (m) at low intensity ($p<0.05$, ES = -1.25), although this difference disappeared when standardised per minute of play, ($p>0.05$, ES = -0.3; Table 2). The work to rest ratio for both distance and time was lower in national players ($p<0.05$, ES = -0.98, $p<0.05$, ES = -0.94, respectively; Table 2).

**Table 1 - Descriptive statistics for playing time characteristics for regional and national players**

| Variable | National Mean ± SD | Range | Regional Mean ± SD | Range | 95% CI of the Difference | Effect Size Descriptive |
|---|---|---|---|---|---|---|
| **Total Time (min:s)** | 16:52 ± 5:50 | 8:17 – 40:02 | 24:15 ± 7:07 * | 15:36 – 40;00 | **-10:10 to -4:35** | **Moderate** |
| **Average Bout Time (min:s)** | 2:27 ± 3:40 | 1:08 – 20:00 | 4:33 ± 5:52 | 1:07 – 20:00 | **-4:22 to 0:12** | **Small** |
| **No. of Bouts** | 9.17 ± 2.40 | 2 – 14 | 9.18 ± 3.88 | 2 – 16 | **-1.5 to 1.4** | **Trivial** |

*** indicates significant difference (*p*<0.05) between regional and national players**

**Table 2 - Descriptive statistics for movement characteristics of national and regional standard players**

| Variable | National | | Regional | | 95% CI | Effect Size Descriptive |
|---|---|---|---|---|---|---|
| | Mean ± SD | Range | Mean ± SD | Range | | |
| **Total Distance (m)** | 2265.76 ± 562.31 | 1202.80 – 4702.20 | 2970.60 ± 558.86 * | 1962.20 – 4412.60 | -951.3 to -458.3 | Large |
| **Total Distance ($m \cdot min^{-1}$)** | 137.12 ± 13.57 | 98.44 – 163.95 | 126.16 ± 17.19 * | 89.25 – 158.93 | 4.3 to 17.5 | Moderate |
| **Low Intensity Distance (m)** | 1650.55 ± 593.80 | 701.3 – 4036.7 | 2404.90 ± 616.43 * | 1629.6 – 4038.7 | -1004 to -503 | Large |
| **Low Intensity Distance ($m \cdot min^{-1}$)** | 98.17 ± 6.36 | 83.9 – 114.3 | 100.61 ± 6.46 | 81.9 – 110.9 | -4.7 to 0.8 | Small |
| **High Intensity Distance (m)** | 619.86 ± 155.16 | 312.5 – 954.5 | 564.85 ± 232.70 | 143.6 – 1096.2 | -36.7 to 146 | Small |
| **High Intensity Distance ($m \cdot min^{-1}$)** | 39.31 ± 11.96 | 10.7- 66.6 | 25.97 ± 13.58 * | 4.6 – 54.8 | 7.8 to 18.8 | Moderate |
| **W:R distance (1 m high: X m low)** | 2.87 ± 1.36 | 1.40 -8.24 | 5.49 ± 3.98 * | 1.74 – 19.10 | -4 to -1.1 | Moderate |
| **W:R time (1 s high: X s low)** | 7.02 ± 3.19 | 3.45 – 16.50 | 13.97 ± 11.57 * | 3.87 – 57.44 | -11.1 to -2.7 | Moderate |

*** indicates significant difference (*p*<0.05) between regional and national players**

The total absolute (m) and relative ($m \cdot min^{-1}$) sprint distance (m) was greater in national compared to regional players ($p$<0.05, ES = 1.0; $p$<0.05, ES = 1.39, respectively; Table 3). There was no difference in the average sprinting distance (m) between the playing standards ($p$>0.05, ES = 0.38). However, the total number and frequency of sprints performed was greater in national players ($p$<0.05, ES = 0.6; $p$<0.05, ES = 1.15, respectively; Table 3). Peak speed was higher in national players ($p$<0.05, ES = 0.8) as well as their average match speed ($p$<0.05, ES = 0.8; Table 3).

Regional players performed at higher percentages of their peak heart rates compared to national players ($p$<0.05, ES = -0.61; Table 4). Similarly, regional players had higher summated heart rates ($p$<0.05, ES = -1.7) and session RPE ($p$<0.05, ES = -1.7; Table 4).

A moderate correlation existed between the number of bouts and high intensity exercise performed (r = 0.56, N=87, $p$<0.05; Figure 1). When considered by standard, strong (r = 0.91, N=53, $p$<0.05; Figure 2) and moderate (r = 0.34, N=54, $p$<0.05; Figure 3) correlations existed between the number of bouts and intensity performed by regional and national players, respectively.

**Table 3 - Descriptive statistics for sprint characteristics of regional and national standard players**

| Variable | National | | Regional | | 95% CI | Effect Size |
|---|---|---|---|---|---|---|
| | Mean ± SD | Range | Mean ± SD | Range | | Descriptive |
| **Sprint distance (m)** | 118.68 ± 59.9 | 29.1 – 274.9 | 68.44 ± 44.54 * | 0.0 – 177.4 | 25.7 to 73.7 | Moderate |
| **Sprint Distance ($m \cdot min^{-1}$)** | 7.67± 4.40 | 1.2 – 20.0 | 3.08 ± 2.30 * | 0.0 – 9.5 | 3.1 to 6 | Large |
| **Average Sprint run distance (m)** | 7.37 ± 2.15 | 3.7 – 14.0 | 6.29 ± 3.52 * | 0.0 – 15.4 | -0.3 to 2.4 | Small |
| **No. of Sprints** | 16.22 ± 7.6 | 6 – 49 | 11.30 ± 6.78 * | 0.0 – 29 | 1.6 to 8 | Moderate |
| **No. of Sprints per minute** | 1.0 ± 0.5 | 0.23 – 2.53 | 0.5 ± 0.37 * | 0.0 – 1.36 | 0.3 – 0.7 | Large |
| **Peak speed ($km \cdot h^{-1}$)** | 26.10 ± 1.79 | 22.3 -30.5 | 24.49 ± 2.26 * | 18.1 – 29.9 | 0.7 to 2.4 | Moderate |
| **Average Speed ($km \cdot h^{-1}$)** | 8.21 ± .76 | 5.9 – 9.5 | 7.51 ± 1.02 * | 5.3 – 9.4 | 0.2 to 1.1 | Moderate |

*** indicates significant difference (*p*<0.05) between regional and national players**

**Table 4 - Descriptive statistics for Internal loads of regional and national standard players**

| Variable | National | | Regional | | 95% CI | Effect Size |
|---|---|---|---|---|---|---|
| | Mean ± SD | Range | Mean ± SD | Range | | Descriptive |
| **Average % peak heart rate** | 80.59 ± 4.27 | 65.4 – 87.2 | 83.46 ± 5.13 * | 66.0 – 90.8 | -5.4 to -0.2 | Moderate |
| **Summated heart rate** | 3359.51 ± 705.51 | 1424 – 4544 | 5640.46 ± 2086.22 * | 2122 – 9985 | -3176 to -1384 | Large |
| **Session RPE** | 73.21 ± 30.67 | 14 – 136 | 142.88 ± 51.22 * | 83 – 280 | -90 to -49 | Large |

*** indicates significant difference (*p*<0.05) between regional and national players**

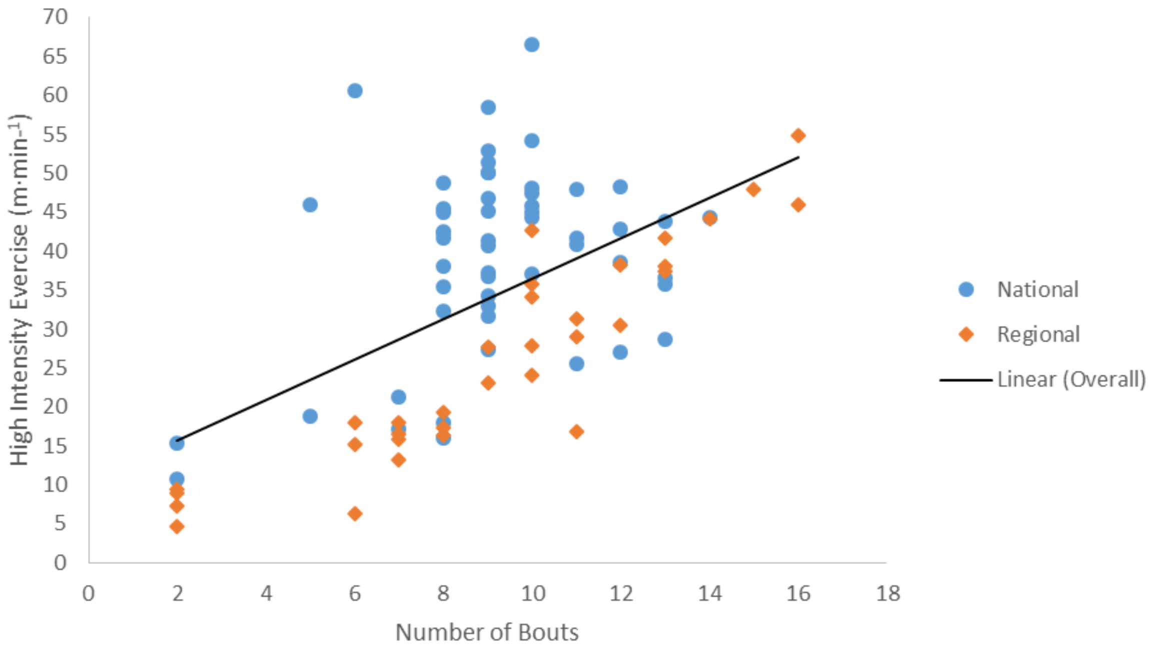


**Figure 1 - Number of bouts and quantity of high intensity work (m·min$^{-1}$).**

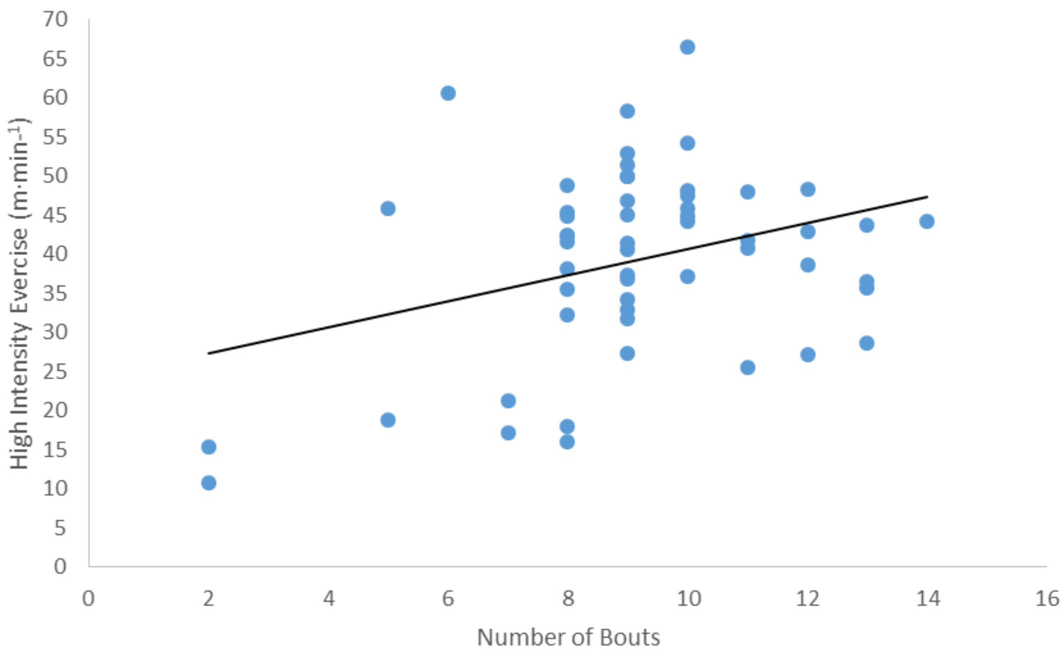


**Figure 2 - Number of bouts and quantity of high intensity work (m·min$^{-1}$) national players.**

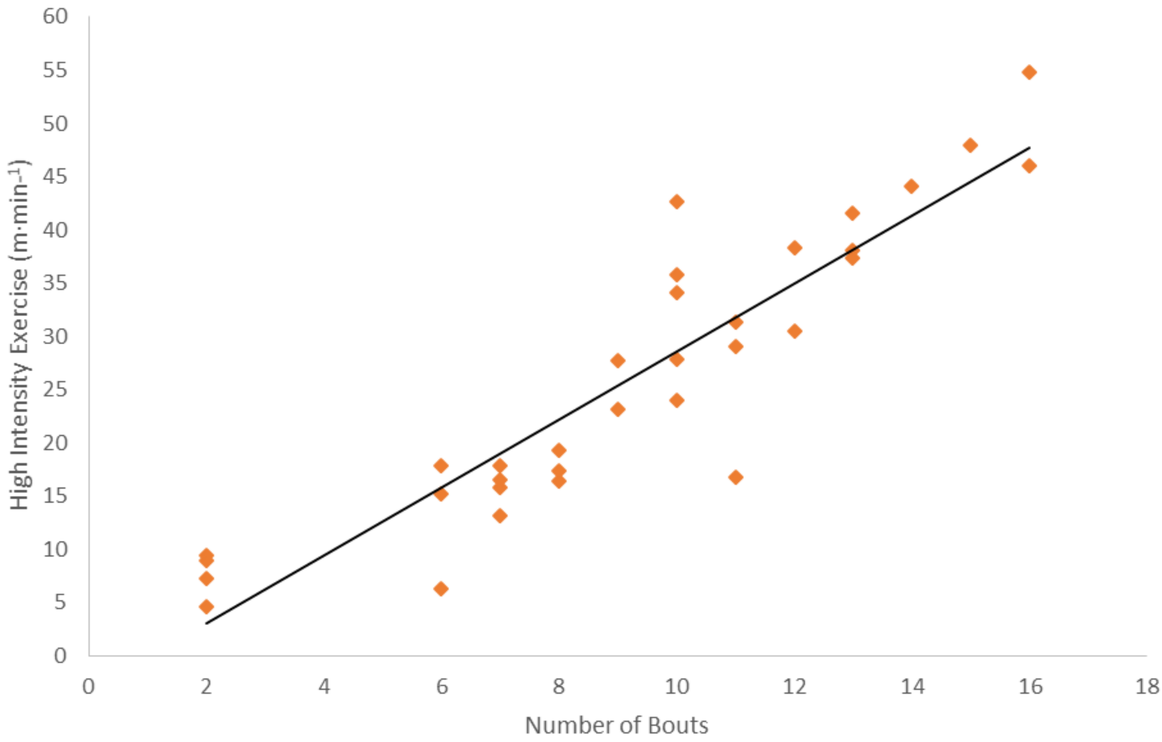


**Figure 3 - Number of bouts and quantity of high intensity work (m·min$^{-1}$) regional players.**

## Chapter 4 - Discussion

To the authors knowledge this is the first study comparing the physiological demands for differing standards of touch rugby matches. Differences in the physical demands of regional and national standard touch matches were observed, namely: the absolute (m) and relative total distance (m·min$^{-1}$) covered; absolute low (m) and relative high intensity (m·min$^{-1}$) distance covered; average and peak match speed (km·h$^{-1}$); work to rest ratio for distance and time; average and summated heart rates; sprint distance (m) and frequency of sprints. The study also demonstrated similarities in some match demands, including: the number of playing bouts; relative low intensity distance (m·min$^{-1}$) covered; absolute high intensity distance (m) covered; and average sprint distance (m).

The average overall distance covered by both national (2265 m) and regional (2570 m) players was up to 60% less compared to other rugby variants at their respective playing levels (Waldron et al., 2011; Suarez-Arrones et al., 2012a; Cahill et al., 2013) and is most likely due to differing match durations (Kennett et al., 2012). When expressed relative to playing time, both national and regional touch players on average covered greater distances than the other rugby variants (by up to 56 $m \cdot min^{-1}$) (Waldron et al., 2011; Suarez-Arrones et al., 2012a; Cahill et al., 2013). This could be due to touch rugby having fewer players on the pitch and unlimited substitutions (allowing frequent recovery periods), which Hill-Hass et al. (2009) has shown increases the total ($m \cdot min^{-1}$) and high intensity ($m \cdot min^{-1}$) distances covered during small-sided games. Therefore, coaches should prescribe training that develops high intensity performance for their touch players, more so compared to that for other rugby codes. For example, training drills could include relatively high running loads incorporating changes in velocity and intermittent high intensity/sprint efforts.

The 31% greater absolute distance (m) covered by regional players (at 2970.6 ± 558.9 m) compared to national players (at 2265.8 ± 562.3 m) contradicts other research comparing playing standards of different team sports; with Bradley et al. 2010, Higham et al. (2012) and Sirotic et al. (2009) reporting greater absolute distances being achieved by more elite players. This is most likely explained by regional players from this study spending more time on the pitch (by 7 minutes 25 seconds; the equivalent to 20% of a total match) compared to their national counterparts, allowing greater absolute distances to be covered. When standardised by time, the average overall relative distance covered by national players (137 m·min$^{-1}$) was 13.5% greater than that achieved by regional players (126 m·min$^{-1}$). This is consistent with research from other rugby codes comparing playing standards (Sirotic et al. 2009) and highlights the importance of rationalising such demands where multiple bouts of differing durations occur (Aughey, 2010). With the relative low intensity distances covered by players of both standards being similar (differing by only 2.4 m·min$^{-1}$), the significantly greater ($p$<0.05) high intensity distance covered by national players is accountable for the overall greater distance (m·min$^{-1}$) covered in the national standard matches. Indeed, national players covered on average 50% more distance relative to playing time at high intensity than their regional counterparts. This aligns with the findings from rugby league (Sirotic et al., 2009) and rugby 7s (Higham et al., 2012), all demonstrating elite players perform at higher intensity during matches. Furthermore, national players achieved higher peak and average match speeds, again supporting the findings of Higham et al. (2012), Mohr et al. (2008) and Sirotic et al. (2009) demonstrating the faster pace of more elite competition. Such movement patterns could be influenced by factors not measured in this study, such as opposition and fellow team-mates ability (Bradley et al., 2012; Gabbett et al., 2013) and tactical decision making (Abelkrim et al., 2010). Elite sportsmen are also reputed to have superior physical capacities and skill levels (Gabbett et al. 2009), which although not quantified in this study may partly explain the observed differences in match intensity between the two playing standards. The large effect sizes for high intensity exercise performed by touch players suggests an ability to perform at higher intensities is important for the performance of national standard matches. Consequently, coaches should develop their player's ability to maintain high intensity exercise during training and matches. In particular, development of regional player's aerobic capacity should improve the ability to perform at greater intensities and reduce the time to recover from such movements (allowing more high intensity work to be undertaken) in preparation for transitioning to the demands of elite status (Gabbett et al., 2013).

The work to rest ratio for time (of 1 second high for 7.2 seconds low) in national players was less by almost 50% compared to regional players (at 1 second high for 13.8 seconds low). Meaning for every second of high intensity play, regional players spent twice as much time at a lower intensity compared to their more elite counterparts. This indicates national players have less on pitch recovery causing them to "work" harder during periods of play (consistent with the observed significant greater distance ($m \cdot min^{-1}$) covered by national players at high intensities). Similarly, the work to rest ratio for distance was also greater in national players (at 2.87 m compared to 5.5 m) further supporting the notion of them working harder from covering a significantly greater distance at high intensity. Such information could be used by coaches within interval based training to aid aerobic conditioning whilst better simulating the demands of competition (Impellizzeri, et al., 2006). Furthermore, when training players for transition to national level, a coach could consider increasing training time at higher intensities and reduce recovery to a similar ratio observed at the national standard (as little as 1:1.4 m or 1:3.4 s; the minimum work to rest ratios in national matches).

The significantly greater absolute (m) and relative ($m \cdot min^{-1}$) total sprint distances in national matches is consistent to that observed in rugby league (Sirotic et al., 2009). With the average individual sprint run distance between the standards being similar (at 7.37 m and 6.29 m for national and regional, respectively), the increased overall sprint distance covered by national players is attributed to their significantly greater sprint frequency. Indeed, national players on average performed one sprint per minute of play whereas regional players performed a sprint, on average, every two minutes. Furthermore, the large effect size reported for sprint frequency emphasizes the increased demand of sprint performance during elite match play. This highlights the importance of including multiple sprint training sessions when preparing players for competition. That said, the use of set speed zones could account for some of the differences between the two groups. Although not measured in the study, such differences may also be due to players having greater anaerobic capacities (Gabbett, 2013) allowing high intensity exercise to be maintained for longer periods. There was a non-significant difference between playing standards for the average sprint run distance (7.37 m and 6.29 m for national and regional players, respectively). This is most likely influenced by the number of players and pitch size, both independent parameters with regards to playing standard (Kennett et al., 2012). Such short average sprint length indicates the importance of acceleration for touch rugby players (Duthie, 2006). As a result, coaches could contain more, short distance sprints within conditioning sessions (for example, 10 x 15 m sprints rather than 3 x 50 m sprints).

The percentage of heart rate that the touch players perform at (irrespective of playing standard) was lower by 1-8% than research from rugby league, union and 7s (Coutts, et al. 2003; Cunniffe, et al., 2009; Suarez-Arrones, Nunez, Portillo & Mendez-Villanueva, 2012b). This affect could be due to the different rules, player numbers and match durations (Casamichana & Castellano, 2010; Kennett et al., 2012; Hill-Hass et al., 2009). Unlike previous research, national players actually participated at a lower percentage of their peak heart rate compared to those at regional level. This may be caused by players participating for shorter bouts times, allowing more off-pitch recovery and therefore insufficient time to attain higher heart rates whilst on the pitch. Also, Gabbett et al. (2013) notes greater internal demands occur when matches are close compared to when there is a clear winner. With the results of the regional matches being much closer than the national matches analysed in this study (with an average score deficit difference of 6), this too could be a contributing factor. Tactical play could also have influenced the physiological load (Abdelkrim et al., 2010), especially on national players where potentially they performed at reduced intensities (and thus lowered heart rates) to preserve their ability to perform in subsequent matches once they were confident the match was won. Both summated heart rate and session RPE were greater (by ~40% and ~50%, respectively) in regional players. It is probable that the significant difference in the quantity of time players spent on the pitch is responsible for such observations as playing duration is a key variable in the calculation of both summated heart rate and session RPE (Foster et al., 2001; Edwards, 1993). However, factor not measured in this study (such as standard of opposition and match results) could also be influencing factors (Bradley et al., 2012; Gabbett et al., 2013).

The overall significant correlation between number playing bouts and high intensity performed suggests players who were selected for a high number of bouts have the ability to perform more high intensity exercise. This is in agreement with Waldron et al. (2013) who found substitute players that played multiple bouts performed more exercise at high intensity than their teammates. The stronger correlation strength in regional players when both playing standards were analysed separately may highlight the ability of national players to maintain high intensity play through a wider variation of playing bout times compared to regional players. That said, too many bouts would result in less recovery time when off the pitch and limit the actual time spent on the pitch. Together, this could mean fewer instances of high intensity performance and when the opportunity for this exists, the player could be too tired to perform it (not having fully recovered). Therefore, a strategy for making substitutions that allows even playing time whilst maximising the number of bouts may optimise the overall quantity of high intensity exercise performed during matches.

## Chapter 5 – Practical Applications

As match demands differ between rugby variants, coaches should not presume that training regimes that work well for other forms of rugby will optimally prepare touch rugby players for competition. Similarly, as the majority of match demand markers differ between the touch rugby playing standards, specific training regimes should be employed to best prepare players for their level of competition. In trying to develop players from a regional to a national level, employing aerobic conditioning and sprint training should be promoted. Short sprint intervals should be used to develop acceleration as average sprint distances are less than 15 m. Also, shorter rest periods to match that observed in competition should be employed. Training drills should include relatively high running loads incorporating changes in velocity and intermittent maximal or near-maximal sprint efforts. From a tactical viewpoint, coaches should be aware that the number of bouts a player performs influences the quantity of high intensity exercise undertaken and the impact this may have on player recovery.

## Chapter 6 - Conclusion

Internal and external physiological match demands imposed on regional and national standard male touch rugby players has been quantified and compared. Significant differences in match demands exist between the touch rugby standards. Therefore, coaches can use the data from this study to devise sport specific training sessions, tailored to the ability level of the player, to better prepare players for touch rugby competition.

## Chapter 7 - References


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## Chapter 8 – Appendices

## Appendix 1 – Example completed consent form.

University of Chester

**Title of Project: The Physiological Match Demands of Touch Rugby.**
**Name of Researcher: Robert Beaven**

Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ✓
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my legal rights being affected. ✓
3. I agree to take part in the above study. ✓

| | | |
|---|---|---|
| | 8/3/13 | |
| Name of Participant | Date | Signature |
| Robert Beaven | 8/3/13 | |
| Researcher | Date | Signature |

1 for participant; 1 for researcher

## Appendix 2 – National governing body consent

# Data - Authorisation

ENGLAND TOUCH

To whom it may concern,

England Touch provides approval from its members to participate in the data collection process to determine the physiological demands of Touch, if they wish to.

Regards

G[redacted] C[redacted]
England Touch – President